

## Appendix 1.1 - Watershed Information Matrix

WATERSHED INFORMATION													
SHED_ID	MAJOR	MINOR	SWQAS	REPORT NO	METRICS	LAST_SUR	INVENTORY	SS03	SS02	SS01	SS00	ROADX	WQ_MONIT
14 100	Grand River	Sand Creek	25300, MI/DEQ/SWQ-00/039	2	Yes	1996	Herman Miller/Volunteer		Not Assessed	Not Assessed	Not Assessed	Complete	
14 89	Grand River	Grand River	001502, 001670, 25300, 003920	4	No	1981			Not Assessed	Not Assessed	Not Assessed		Reeds Lake (Nutrients, chloro, E. coli, DO) KCHD (E. coli)
14 89A	Grand River	York Creek (Minor)	25300, MI/DNR/SWQ-93/019, MI/DNR/SWQ-95/064	3	No	1994			Poor	Poor/Fair	Poor/Fair		
14 89B	Grand River	Coldbrook Creek (Minor)	25300	1	No	1968			Not Assessed	Poor	Not Assessed		
14 89C	Grand River	Lamberton Creek (Minor)	25300	1	No	1968			Fair	Good	Good		
14 89D	Grand River	Comstock-Sligh											
14 89E	Grand River	Graceland-Lacey											
14 93	Grand River	Buck Creek	25300, MI/DNR/SWQ-92/212	2	No	1991			Not assessed	Good	Not Assessed		Calvin Christian High School
14 94	Grand River	Buck Creek	25300, MI/DNR/SWQ-92/212	2	No	1991			Poor	Good	Good		KCHD (Buck Creek--E. coli)
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)	25300	1	No	1968			Not assessed	Good	Fair/Excellent		KCHD (Buck Creek--E. coli)
14 96	Grand River	Rush Creek	25300	1	No	1968			Not Assessed	Not Assessed	Not Assessed		
14 97	Grand River	Grand River	00690, 001502, 25300, 003920, MI/DEQ/SWQ-96/056	5	Yes	1996			Not Assessed	Not Assessed	Not Assessed		STORET (Grand River @ M-11), KCHD (Grand River--E.coli)
14 97A	Grand River	Roy's Creek (Minor)	25300, 002780, 004620	3	No	1984			Not Assessed	Not Assessed	Not Assessed		
14 97B	Grand River	Hogadone											
14 98	Grand River	East Fork Creek	25300, MI/DEQ/SWQ-00/038	2	Yes	1996	Herman Miller/Volunteer		Not Assessed	Not Assessed	Not Assessed	Complete	
14 99	Grand River	Sand Creek	25300, MI/DEQ/SWQ-00/039	2	Yes	1996	Herman Miller/Volunteer		Not Assessed	Not Assessed	Not Assessed	Complete	

\* P = Pathogens  
 PFC = Poor Fish Community  
 PMC = Poor Macro Invertebrate Community  
 M = Mercury  
 P = Phosphorus  
 PCB = Polychlorinated Biphenyls  
 FK = Fish Kills  
 N = Nutrients  
 SD = Untreated Sewage Discharge  
 DO = Dissolved Oxygen Violations  
 S = Sediment

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SHED_ID	MAJOR	MINOR	FISH_CON	TMDL	TMDL_DATE	TROUT	WMP	WMP_STATUS	WMP_ACT	WMP_TYPE	GIS	BMP	IE	HYDRO
14 100	Grand River	Sand Creek	Inland Lakes Mercury Advisory	PFC	2006	Sand Creek and its unnamed tribs	Sand Creek	Started	Moderate	NA	YES	NO	YES	In Progress
14 89	Grand River	Grand River	Inland Lakes Mercury Advisory, Grand River PCBs, Reeds Lake PCBs	PCB, M	2010, 2011		None	Not Started	NA	NA	NA	NA	NA	NA
14 89A	Grand River	York Creek (Minor)	Inland Lakes Mercury Advisory	PFC	2006	York Creek	York Creek	Completed	Moderate	319	YES	YES	YES	YES
14 89B	Grand River	Coldbrook Creek (Minor)	Inland Lakes Mercury Advisory	None			None	Not Started	NA	NA	NA	NA	NA	NA
14 89C	Grand River	Lamberton Creek (Minor)	Inland Lakes Mercury Advisory	None		Lamberton Creek	None	Not Started	NA	NA	NA	NA	NA	YES
14 89D	Grand River	Comstock-Sligh	Inland Lakes Mercury Advisory	None										YES
14 89E	Grand River	Graceland-Lacey	Inland Lakes Mercury Advisory	None										YES
14 93	Grand River	Buck Creek	Inland Lakes Mercury Advisory	None		Buck Creek	None	Not Started	NA	NA	NA	NA	NA	NA
14 94	Grand River	Buck Creek	Inland Lakes Mercury Advisory	P	2006	Sharps Creek, Pine Hill Creek, Buck Creek and Unnamed trib of Buck Creek	None	Not Started	NA	NA	NA	NA	NA	NA
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)	Inland Lakes Mercury Advisory	None			None	Not Started	Low	NA	NO	YES	NO	YES
14 96	Grand River	Rush Creek	Inland Lakes Mercury Advisory	None			None	Not Started	Low	NA	NO	YES	NO	YES
14 97	Grand River	Grand River	Inland Lakes Mercury Advisory	P	2006	Unnamed trib.	None	Not Started	NA	NA	NA	NA	NA	NA
14 97A	Grand River	Roy's Creek (Minor)	Inland Lakes Mercury Advisory	None		Roy's Creek	None	Not Started	NA	NA	NA	NA	NA	NA
14 97B	Grand River	Hogadone	Inland Lakes Mercury Advisory	None										YES
14 98	Grand River	East Fork Creek	Inland Lakes Mercury Advisory	PFC	2005	Sand Creek and its unnamed tribs	Sand Creek	Started	Moderate	NA	NO	NO	NO	NO
14 99	Grand River	Sand Creek	Inland Lakes Mercury Advisory	PFC	2006	Sand Creek and its unnamed tribs	Sand Creek	Started	Moderate	NA	NO	NO	NO	NO

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WATERSHED INFORMATION			WATERSHED PLANNING										
SHED_ID	MAJOR	MINOR	WELL	WELL_STAT	WELL_GIS	STORM_MP	STUDY	WS_TYPE	FLOOD_MAP	WQ_MP	SW_ORD		
14 100	Grand River	Sand Creek	NO	NA		NONE	An Assessment of Water Quality and Aquatic Habitat and Recommendations for the Sand Creek Watershed (1996)	Rural	YES	YES			
14 89	Grand River	Grand River	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994), Grand Rapids Twp (In Progress)	Combined Sewer Overflow Study (1990)	Urban, Grand River	YES				
14 89A	Grand River	York Creek (Minor)	NO	NA				Urban					
14 89B	Grand River	Coldbrook Creek (Minor)	NO	NA		Coldbrook Creek Storm Water Management Plan (1986), Grand Rapids, MI, Storm Water Management Plan (1994), Grand Rapids Twp (In Progress)		Urban	YES				
14 89C	Grand River	Lamberton Creek (Minor)	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)		Urban	YES				
14 89D	Grand River	Comstock-Sligh	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)							
14 89E	Grand River	Graceland-Lacey	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)							
14 93	Grand River	Buck Creek	NO	NA		Byron Township Storm Sewer Master Plan Sections 15, 16, 21, and 22 (1977), Buck Creek and Plaster Creek Storm Water Management Master Plan (1991), Gaines Twp (In Progress)		Rural, Urban					
14 94	Grand River	Buck Creek	NO	NA		Buck Creek and Plaster Creek Storm Water Management Master Plan (1991), Wyoming Storm Water Management Master Plan Sections 28-35 (1996), Gaines Twp (In Progress)	Kentwood Detention Ponds (1985)	Urban, Rural	Behan-Foley Drain Floodplain Analysis (1993)				
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)	NO	NA		Bliss Creek Intercounty Drain WMP (1994)		Rural, Urban					
14 96	Grand River	Rush Creek	NO	NA		Huizenga Intercounty Drain Watershed Management Plan (1995)		Urban, Rural, Lake					
14 97	Grand River	Grand River	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)	Combined Sewer Overflow Study (1990)	Urban, Grand River, Rural					
14 97A	Grand River	Roy's Creek (Minor)	NO	NA			Watershed Study 1997						
14 97B	Grand River	Hogadone	NO	NA		City of Grand Rapids, MI, Storm Water Management Master Plan (1994)							
14 98	Grand River	East Fork Creek	NO	NA		In progress, will adopt Kent County Model Ordinance in Walker, Alpine Twp (In Progress)		Rural, Urban					
14 99	Grand River	Sand Creek	NO	NA				Rural	FEMA	Stream set-back ordinances			

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WATERSHED INFORMATION			LAND USE PLANNING				LOCAL PARTICIPATION					
SHED_ID	MAJOR	MINOR	IMP_COVER	LU_CHANGE	CAFO	MNFI	SUPERFUND	PHASE2	FUNDING	AAS	CON_ORG	TIMBER
14 100	Grand River	Sand Creek				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050006%2014%20100">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050006%2014%20100</a>	NONE	Walker, Tallmadge Twp			Marne Conservation Club, Friends of the Musketawa Trail, Ottawa Conservation District	YES
14 89	Grand River	Grand River				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089</a>	<b>Butterworth #2 Landfill</b> (MID062222997, continued monitoring until 2030), <b>Reliable Equipment</b> (MID006407969, removed)	Grand Rapids, Plainfield Twp, Alpine Twp, Grand Rapids Twp, East Grand Rapids, Kentwood				YES
14 89A	Grand River	York Creek (Minor)				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089</a>	NONE	Walker, Alpine Twp				YES
14 89B	Grand River	Coldbrook Creek (Minor)				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089</a>	NONE	Grand Rapids, East Grand Rapids, Grand Rapids Twp		Aquinas College-Biology		YES
14 89C	Grand River	Lamberton Creek (Minor)				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089</a>	NONE	Grand Rapids, Plainfield Twp, Grand Rapids Twp		Westwood Middle School, Riverside Park		YES
14 89D	Grand River	Comstock-Sligh				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089</a>	NONE					
14 89E	Grand River	Graceland-Lacey				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2089</a>	NONE					
14 93	Grand River	Buck Creek				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2093">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2093</a>	NONE	Wyoming, Byron Twp, Gaines Twp				YES
14 94	Grand River	Buck Creek				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2094">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2094</a>	NONE	Grandville, Wyoming, Grand Rapids, Kentwood, Gaines Twp, Byron Twp				YES
14 95	Grand River	East Branch Rush Creek (Bliss Creek Drain)				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2095">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2095</a>	NONE	Georgetown Twp, Grandville, Jamestown Twp, Wyoming, Byron Twp				YES
14 96	Grand River	Rush Creek				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2096">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2096</a>	NONE	Grandville, Georgetown Twp, Hudsonville, Blendon Twp, Wyoming				YES
14 97	Grand River	Grand River				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2097">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2097</a>	<b>H. Brown Company, Inc.</b> (MID017075136, continued monitoring until 2004), <b>Organic Chemical Co.</b> (MID990858003, continued monitoring until 2032), <b>Spartan Chemical Co.</b> (MID079300125, monitoring until 2003)	Walker, Grand Rapids, Tallmadge Twp, Wyoming, Grandville				YES
14 97A	Grand River	Roy's Creek (Minor)				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2097">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2097</a>	NONE	Wyoming				YES
14 97B	Grand River	Hogadone				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2097">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2097</a>	NONE					
14 98	Grand River	East Fork Creek				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2098">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2098</a>	NONE	Alpine Twp, Walker, Wright Twp, Tallmadge Twp			Friends of the Walker/Highland Trail	YES
14 99	Grand River	Sand Creek				<a href="http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2099">http://web4.msue.msu.edu/mnfi/data/watshd_dat.cfm?id=4050004%2014%2099</a>	NONE	Wright Twp			Marne Conservation Club, Friends of the Musketawa Trail	YES

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MI/DNR/SWQ-92/212

MICHIGAN DEPARTMENT OF NATURAL RESOURCES  
SURFACE WATER QUALITY DIVISION  
APRIL, 1992

STAFF REPORT

A BIOLOGICAL SURVEY OF BUCK CREEK  
KENT COUNTY, MICHIGAN  
JUNE 19, 1991

As part of the point and nonpoint source surveillance activities, a biological survey was conducted on Buck Creek, a designated coldwater stream that flows through the city of Grand Rapids in Kent county. The objective of this survey was to assess the impact of the two point source discharges and surrounding general land use on the stream. The biological survey was conducted according to GLEAS Procedure 51 (available upon request).

The Station 1 and 2 segments of Buck Creek were determined to be third order stream segments. Station 3 was located on Sharps Creek, a tributary of Buck Creek, and was considered a first order stream segment. All stations lie within the Southern Michigan / Northern Indiana Till Plain. The two point sources on Buck Creek are De Bruyn Produce Co. (NPDES# MI0043532), which discharges process and noncontact cooling water, and DeJager Construction Co. (NPDES# MI0002810), which discharges groundwater used as noncontact cooling water.

SUMMARY

- 1) The locations of the sampling stations are shown in Figure 1. Fish community, aquatic macroinvertebrate community, habitat, and overall stream quality evaluation data are presented in Tables 1 through 4, respectively. Length/frequency data for Brown Trout are presented in Appendix 1.
- 2) Fish community structure was rated good (slightly impaired) at Stations 1 and 3 and fair (moderately impaired) at Station 2; however, the total scores for Stations 2 and 3 were close. Macroinvertebrate communities were reduced at all three stations, and rated fair at Station 1 and poor (severely impaired) at Stations 2 and 3. Station 2 in particular had a low diversity of macroinvertebrates, with only 7 taxa found. Overall stream quality of Buck Creek was rated fair at Station 1 and poor at Stations 2 and 3, based on the condition of the aquatic macroinvertebrate communities.
- 3) The physical habitat conditions of Stations 1, 2, and 3 were rated good, fair, and poor, respectively. Sedimentation was observed at all sites but to a greater degree at Stations 2 and 3, contributing to the severe impact on the

macroinvertebrate communities by covering colonizable substrate. Storm water runoff contributes substantially to flow fluctuations at Station 3, also impacting macroinvertebrate communities by periodically scouring the stream bed.

- 4) Visual observations of local land use patterns suggest that urbanization, with associated sedimentation and flow fluctuations from stormwater runoff, has caused impairment of physical habitat conditions in Buck Creek at Stations 2 and 3. Habitat quality improved in the downstream direction, suggesting that increased flow is clearing some of the sediment. However, macroinvertebrate communities at Stations 1 and 2 were more impacted than habitat conditions alone would indicate. These two stations, unlike Station 3, are downstream from both point source discharges into the creek. This may indicate an impact from either or both of these facilities.

Survey by: John Wuycheck, Aquatic Biologist  
Andrew Scott, Aquatic Biologist

Report by: Sandra Kosek, Aquatic Biologist  
Water Quality Appraisal Unit  
GLEAS

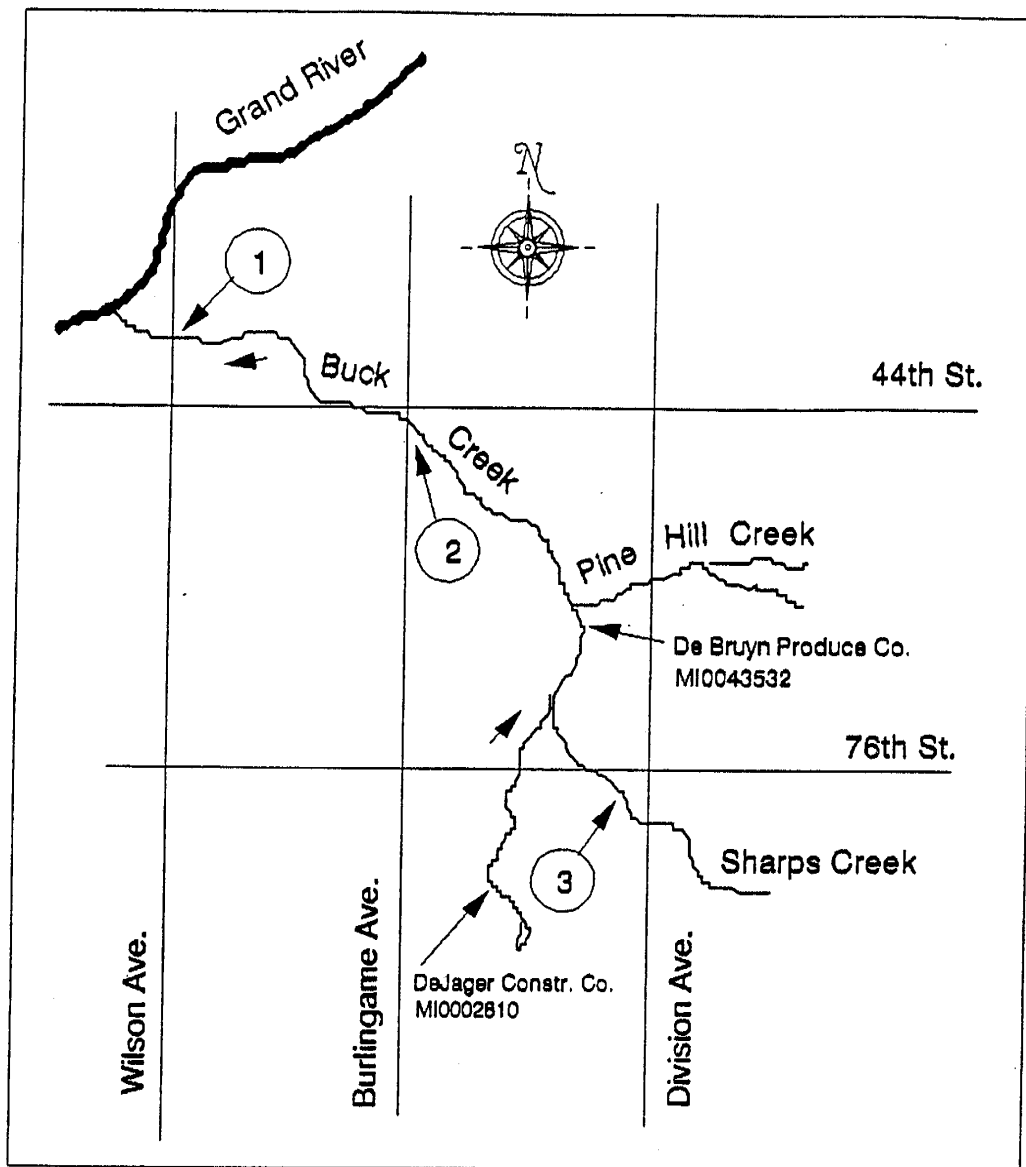


Figure 1: Biological Survey Stations on Buck Creek,  
Kent County, June 19, 1991.

① = survey station.

Table 1A. Qualitative fish sampling results for Buck Creek, Kent County, June 19, 1991.

TAXA	STATION 1	STATION 2	STATION 3
Salmonidae (Trouts)			
Salmo trutta (Brown trout)	2	6	
Umbridae (Mudminnows)			
Umbra limi (Central mudminnow)			1
Esocidae (Pikes)			
Esox americanus ver. (Grass Pike)		1	
Cyprinidae (Minnows and Carps)			
Cyprinus carpio (Carp)		8	
Semotilus atromaculatus (Creek)			3
N. cornutus (Common shiner)	30		
Cottidae (Sculpins)			
Cottus bairdi (Mottled sculpin)			2
Catostomidae (Suckers)			
Catostomus commersoni (W. sucker)	8	12	2
Moxostoma anisurum (Silver redh.)	4		
Minytrema melanops (Spotted skr.)		3	
Gasterosteidae (Sticklebacks)			
Culaea inconstans (Brook)		1	
Centrarchidae (Sunfish)			
Ambloplites rupestris (Rock bass)	1		
Lepomis cyanellus (Green sunfish)	1		
L. macrochirus (Bluegill)	2	2	2
P. nigromaculatus (Black crappie)		1	
Micropterus salmoides (Lm. bass)	1		
Percidae (Perches)			
E. nigrum (Johnny darter)			1
TOTAL INDIVIDUALS	49	34	11
NUMBER OF ANOMALIES			
SQUARE FOOT SAMPLED	10500	11500	2600
DENSITY OF INDIVIDUALS (#/SF)	0.005	0.003	0.004

Table 1B. Fish metric evaluation of Buck Creek, Kent County, June 19, 1991.

METRIC	STATION 1		STATION 2		STATION 3	
	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	8	5	8	5	6	3
NUMBER OF DARTER SPECIES	0	1	0	1	1	3
NUMBER OF SUNFISH SPECIES	3	3	2	3	1	3
NUMBER OF SUCKER SPECIES	2	5	2	5	1	3
PERCENT CARP, G.SUNFISH, W.SUCKER	18.4	3	58.8	1	18.2	3
PERCENT OMNIVORES	16.3	5	58.8	1	18.2	5
PERCENT INSECTIVO. CYPRINIDS	61.2	5	0.0	1	0.0	1
PERCENT PISCIVORES	4.1	3	2.9	3	0.0	1
DENSITY OF INDIVIDUALS	0.005	3	0.003	1	0.004	1
PERCENT ANOMALIES	0.0	5	0.0	5	0.0	5
TOTAL SCORE		38		26		28
FISH COMMUNITY CATEGORY		GOOD (SLIGHTLY IMPAIRED)		FAIR (MODERATELY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)



Table 2A. Qualitative macroinvertebrate sampling results for Buck Creek, Kent County, June 19, 1991.

TAXA	STATION 1	STATION 2	STATION 3
PLATYHELMINTHES (flatworms)	3		1
ARTHROPODA			
Isopoda (sowbugs)	8	10	10
Amphipoda (scuds)	20	15	10
Decapoda (crayfish)	4	8	8
Insecta			
Ephemeroptera (mayflies)			
Ephemerellidae	1		1
Odonata			
Zygoptera (damselflies)			
Calopterygidae		4	8
Coenagrionidae	1		1
Hemiptera (true bugs)			
Corixidae	2		20
Gerridae		10	10
Trichoptera (caddisflies)			
Hydropsychidae	13		6
Leptoceridae			1
Coleoptera (beetles)			
Halplidae (adults)	1		3
Hydrophilidae (total)	1		
Elmidae	3		
Diptera (flies)			
Simuliidae	15	2	
Chironomidae	4	4	5
MOLLUSCA			
Gastropoda (snails)			
Physa	1		1
Pelecypoda (clams)			
Sphaerium			2
TOTAL INDIVIDUALS	77	53	87

Table 2B. Macroinvertebrate metric evaluation of Buck Creek, Kent County, June 19, 1991.

METRIC	STATION 1		STATION 2		STATION 3	
	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	14	4	7	0	15	2
NUMBER OF MAYFLY TAXA	1	0	0	0	1	0
NUMBER OF CADDISFLY TAXA	1	0	0	0	2	0
NUMBER OF STONEFLY TAXA	0	0	0	0	0	0
PERCENT MAYFLY COMP.	1.3	0	0.0	0	1.1	0
PERCENT CADDISFLY COMP.	16.9	0	0.0	0	8.0	0
PERCENT CONTR. DOM. TAXON	26.0	4	28.3	4	23.0	4
PERCENT ISOPOD, SNAIL, LEECH	11.7	0	18.9	0	12.6	0
PERCENT SURFACE AIR BREATHERS	5.2	4	18.9	4	37.9	2
TOTAL SCORE		12		8		8
MACROINVERTEBRATE COMMUNITY CATEGORY	FAIR (MODERATELY IMPAIRED)		POOR (SEVERELY IMPAIRED)		POOR (SEVERELY IMPAIRED)	

Table 3. Habitat evaluation for Buck Creek, Kent County, June 19, 1991.

HABITAT METRIC	STATION 1 SCORE	STATION 2 SCORE	STATION 3 SCORE
Bottom Substrate			
Available Cover:	12	7	2
Embeddedness:	12	6	0
Velocity:Depth:	16	11	3
Flow Stability:	9	10	6
Bottom Deposition:	7	7	2
Pools-Riffles- Runs-Bends:	11	6	5
Bank Stability:	7	7	6
Bank Vegetative Stability:	6	9	8
Streamside Cover:	6	8	5
TOTAL SCORE	86	71	37
HABITAT CONDITION CATEGORY	GOOD (SLIGHTLY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	POOR (SEVERELY IMPAIRED)
Date:	June 19, 1991	June 19, 1991	June 19, 1991
Stream Type:	Coldwater	Coldwater	Coldwater
Weather:	Sunny	Sunny	Sunny
Stream Order:	Third	Third	First
Air Temperature:	72 Deg. F.	73 Deg. F.	80 Deg. F.
Water Temperature:	64.5 Deg. F.	62 Deg. F.	64 Deg. F.
Ave. Stream Width:	35 Feet	25 Feet	13 Feet
Ave. Stream Depth:	1 Feet	2 Feet	1 Feet
Surface Velocity:	0.75 Ft./Sec.	0.5 Ft./Sec.	0.25 Ft./Sec.
Estimated Flow:	26 CFS	25 CFS	3 CFS

Table 4. Overall Stream Quality of Buck Creek, Kent County, June 19, 1991.

STATION NUMBER	STATION LOCATION	FISH COMMUNITY	MACROINVERTEBRATE COMMUNITY	PHYSICAL HABITAT	OVERALL BIOLOGICAL
1	Buck Creek Wedgewood Park	GOOD	FAIR	GOOD	FAIR
2	Buck Creek Burlingame/44th	FAIR	POOR	FAIR	POOR
3	Sharps Creek Division/76th	GOOD	POOR	POOR	POOR

APPENDIX I:

Length/Frequency Data for Brown Trout in Buck Creek,  
Kent County, Michigan.

Date 6/19/91

Sheet 1 of 1

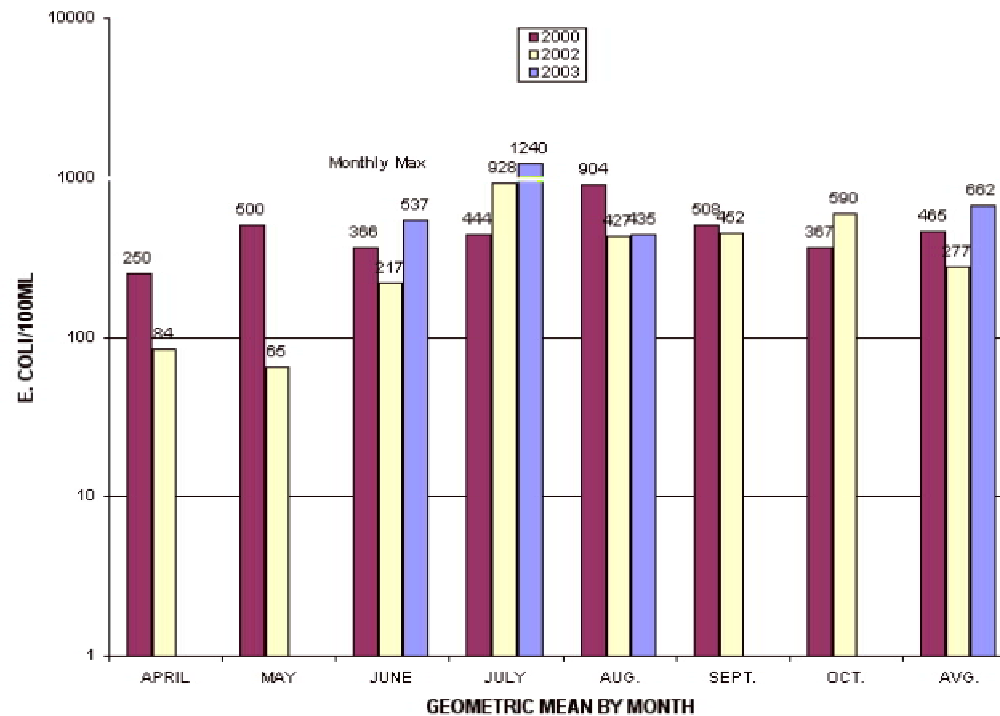
mary of: ☒ All sites ( ) Coll. site No. \_\_\_\_\_ ( ) Index site No. \_\_\_\_\_ ( ) All gear ( ) Gear \_\_\_\_\_

[illegible]

## Appendix 3.2 - Kent County Health Department Buck Creek Station No. 15

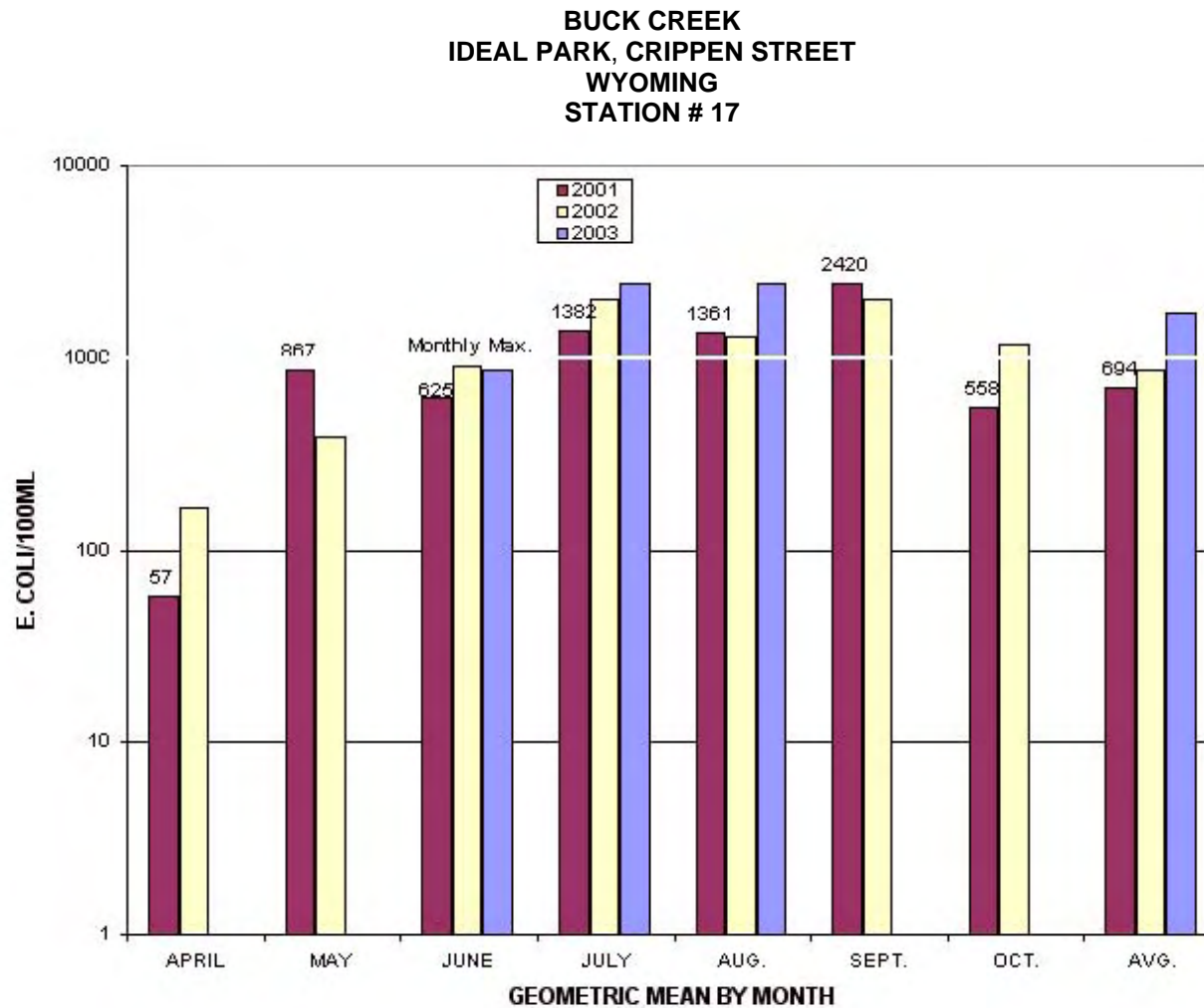
KENT COUNTY HEALTH DEPARTMENT  
SURFACE WATER QUALITY MONITORING

BUCK CREEK  
DOUGLAS WALKER PARK  
BYRON TOWNSHIP  
STATION # 15



## Appendix 3.2 - Kent County Health Department Buck Creek Station No. 17

### KENT COUNTY HEALTH DEPARTMENT SURFACE WATER QUALITY MONITORING



## Appendix 3.3 - Buck Creek Watershed Inventory Data Sheet

### Watershed Inventory Data Sheet

#### Buck Creek Watershed

Date

Investigator

Water Body Name

Site Reference

Site ID#

Pollutant Source (choose only one, complete section)

- |                     |                             |                    |                          |
|---------------------|-----------------------------|--------------------|--------------------------|
| 1. Debris/Trash     | 2. Construction Site Runoff | 3. Stream Crossing | 4. Rill or Gully Erosion |
| 5. Livestock Access | 6. Upland Source            | 7. Tile Outlet     | 8. Streambank Erosion    |
| 9. Urban Runoff     |                             |                    |                          |
| 10. Other: _____    |                             |                    |                          |

<b>County</b>	Kent	<b>Township</b>		<b>Section #</b>	0.25	0.25	
<b>Tract #(s)</b>		<b>Owner</b>					
<b>Current precipitation</b>	None	Light	Moderate	Heavy			
<b>Days since last rain</b>	1 or less	2	3 or more	How much?	inches		
<b>Water Color</b>	Clear	Green	Milky	Brown	Very Muddy	Black	
<b>Water Odor</b>	None	Musty	Rotten Eggs	Chemical	Oil	Sewage	
<b>Stream flow type</b>	Dry	Stagnant	Slow Flow	Rapid Flow			
<b>Average Stream Width</b>	10' or less	11' - 25'	25' - 50'	50' or more			
<b>Average Stream Depth</b>	<1'	1' - 3'	>3'	Don't know			
<b>Riparian Habitat</b>			Herbaceous				
<b>Buffer/Filter Strip</b>	Trees	Shrubs	plants		Grass	Bare	
<b>Land Use (facing u/s)</b>	Y / N	Width	<1'	1' - 3'	3' - 10'	>10'	
	Left	Road	Woodland	Wetland	Idle	Agricultural	Res/Comm
	Right	Road	Woodland	Wetland	Idle	Agricultural	Res/Comm
<b>Comments:</b>							

#### SECTION 1. DEBRIS/TRASH/OBSTRUCTIONS

Slight	Moderate	Extensive	Description: _____
Organic Waste Dumping	Left bank	Right Bank	Type: _____

#### SECTION 2. CONSTRUCTION SITE RUNOFF

Location	Left Bank	Right Bank		
Construction type	road	residential	industrial	other
Soil erosion measures	not installed	needs repair	not adequate	
Sedimentation control measures	not installed	needs repair	not adequate	
Extent of erosion/sedimentation	slight	moderate	severe	



# Appendix 3.4 - Nonpoint Source Data

## Trash and Debris

SITE ID NUMBER	DATE	Trash and	PHOTO	TOWNSHIP	LAND USE LEFT	LAND USE RIGHT	TYPE OF TRASH AND DEBRIS	AMOUNT	COMMENTS
08BYR3601	26-Jun-03	BUCK CREEK	NO	BYRON CENTER	IDLE	IDLE	LOG JAM OBSTRUCTING FLOW OF CREEK	SLIGHT	
1154GRC2107	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		EXCESSIVE SAND AND TREES, LEAVES, BRANCHES BLOCKING WATERWAY. ALSO, CHAIR AND MISC. TRASH.
1154GRC2110	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		LOOKS LIKE CAR OIL
1154GRC2116	25-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
1154GRC2117	25-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
1154GRC2809	3-Jul-03		NO	GRANDVILLE			PRESENT		
1154WYO2116	21-Aug-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		
1154WYO3333	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3337	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3339	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GLASS CLIPPINGS ON THE BANK
1154WYO3347	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3348	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3357	25-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1156BYR2217	30-Jun-03	TRIBUTARY (1155)	YES	BYRON CENTER			PRESENT		NOT COMPLETELY FULL...JUST BEHIND HOUSES
1156BYR2218	1-Jul-03	TRIBUTARY (1155)	YES	BYRON CENTER			PRESENT		
1157BYR1323	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1324	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1325	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1326	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
11601GAI0838	6-Jun-03	TRIBUTARY (11601)	YES	GAINES TWP			PRESENT		CRYSTAL SPRINGS, GRASS CLIPPINGS BY POND
11611GAI0859	9-Jun-03	CUTLERVILLE DRAIN (TRIBUTARY)	YES	GAINES TWP			PRESENT		
1161BYR0126	17-Jun-03	CUTLERVILLE DRAIN	YES	BYRON CENTER			PRESENT		YARD WASTE ON STREAM BANK
1161GAI0620	23-May-03	CUTLERVILLE DRAIN	YES	GAINES TWP			PRESENT		
11631KEN2801	6-Aug-03	TRIBUTARY (11631)	YES	KENTWOOD	RES/COMM	RES/COMM	PARKING LOT RUNOFF / TRASH IN STREAM	MODERATE	RETENTION BASIN UPSTREAM / TRASH IN STREAM
11631KEN2901	6-Aug-03	TRIBUTARY (11631)	NO	KENTWOOD	RES/COMM	RES/COMM	GRASS CLIPPINGS ALONG LEFT BANK	SLIGHT	
11632WYO1811	14-Aug-03	HEYBOER DRAIN #2	YES	WYOMING			PRESENT		TWO HUGE CULVERTS
11632WYO1815	14-Aug-03	HEYBOER DRAIN #2	YES	WYOMING			PRESENT		
1163WYO2505	5-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		
1163WYO3614	5-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		TRASH, TREES AND STICKS ALMOST COMPLETELY RESTRICTING WATERWAY
1163WYO3628	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		TRUCK DUMP(WATER OR SOME LIQUID), BANK IS ERODED & THERE IS A LOT OF CARDBOARD TRASH. ALGAE GROWING ON GROUND
59GAI0402	4-Aug-03	PINE HILL CREEK	NO	GAINES TWP	RES/COMM	RES/COMM	GRASS CLIPPINGS ALONG BOTH BANKS	SLIGHT	
59KEN3105	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	IDLE		DEBRIS IN WATER	EXTENSIVE	
59KEN3302	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD		WOODLAND	DEBRIS IN WATER	EXTENSIVE	
6511BYR1316	19-Jun-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER			PRESENT		
65BYR1227	3-Jul-03	76TH STREET INDUSTRIAL PARK DRAIN	YES	BYRON CENTER			PRESENT		TRUNED OVER TRUCK, BEEN THERE FOR QUITE A WHILE, RUSTED
65BYR1228	3-Jul-03	76TH STREET INDUSTRIAL PARK DRAIN	YES	BYRON CENTER			PRESENT		GRASS CLIPPINGS
65BYR1232	3-Jul-03	76TH STREET INDUSTRIAL PK. DRAIN	YES	BYRON CENTER			PRESENT		GRASS CLIPPINGS AND YARD WASTE
65BYR1261	9-Jul-03	TRIBUTARY (65)	YES	BYRON CENTER			PRESENT		CAGE/BED FRAME BLOCKING WATER WAY, THERE IS AN EXTREME AMOUNT OF SEDIMENT AND GROWTH IN CAGE
674BYR2501	17-Oct-03	UNKNOWN (674)	YES	BYRON CENTER	IDLE	RES/COMM	BROKEN PVC PIPES	EXTENSIVE	BROKEN PVC PIPES IMPEDING FLOW THROUGH CULVERT (WEST OF DIVISION - DOWN STREAM)
675GAI0514	10-Jun-03	WATERMAN DRAIN	YES	GAINES TWP			PRESENT		WOODCHIPS OVERFLOWING INTO CREEK, YARD WASTE NEXT TO IT
8BYR0118	17-Jun-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		
8BYR0121	17-Jun-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		WHOLE POND IS TRASHED... FOAM INSULATION, 2X4'S, TRASH CANS, GRILLS, STEEL BEAMS, BED FRAMES, TIRES, ETC.
8BYR1236	7-Jul-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		OTHER DEBRIS DOWNSTREAM--FROM HERE OR PROBABLY NEXT COMPANY TO THE NORTH
8BYR1255	8-Jul-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		
8GRC1607	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC1713	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC1815	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC2124	25-Aug-03	BUCK CREEK	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
8WYO2112	21-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		YARD DEBRIS
8WYO2219	12-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		VARIOUS BITS OF TRASH--PROBABLY FROM UPSTREAM.
8WYO2301	22-Jul-03	UNKNOWN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO2515	12-Aug-03	UNNAMED LAKE	YES	WYOMING			PRESENT		
8WYO2706	17-Jul-03	WETLAND	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO2816	31-Jul-03	UNKNOWN	YES	WYOMING			PRESENT		CAT LITTER
8WYO3386	29-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3413	17-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT		DEBRIS AROUND AND IN LAKE FROM CONSTRUCTION AND BUSINESSES
8WYO3629	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		REASH (WATER BOTTLES, SPRAY CANS, CHIP BAGS)
8WYO3634	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3636	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3645	7-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		

Date:

Waterbody Name:

Location:

Investigator:

Coordinate Determination Method (check the one that applies):

☐ GPS ☐ GPS w/ DBR ☐ Digital mapping software ☐ Topographic map ☐ Other (describe \_\_\_\_\_)

Map Scale (if known \_\_\_\_\_)

**Watershed Survey Data Sheet**

County:

Township:

Lat:

Time:

Station #:

Sec T R ¼ ¼

Long:

**PHYSICAL HABITAT****BACKGROUND INFORMATION - pg. 18****PHYSICAL APPEARANCE - pg. 20**

Event Conditions noted at site	None				Light				Moderate				Heavy				Aquatic Plants	U/S (Check all that apply)		D/S (Check all that apply)					
	None				Light				Moderate				Heavy					Present	Abundant	Present	Abundant				
Days since Rain	≤ 1				2				3				Unknown				Floating Algae	Present	Abundant	Present	Abundant				
Water Temp./D.O./pH *																	Filamentous Algae	Present	Abundant	Present	Abundant				
Water Color	Clear				Gray				Brown				Black				Green				Bacterial Sheen/Slimes	Present	Abundant	Present	Abundant
Waterbody Type-u/s	Stream				Lake				Impd				Wetland				Turbidity	Present	Abundant	Present	Abundant				
Waterbody Type-d/s	Stream				Lake				Impd				Wetland				Oil Sheen	Present	Abundant	Present	Abundant				
Stream Width (ft.)	<10				10-25				25-50				>50				Foam	Present	Abundant	Present	Abundant				
Avg Stream Depth (ft.)	<1				1-3				>3				Unknown				Trash	Present	Abundant	Present	Abundant				
Water Velocity (ft/sec)																									
Stream Flow Type	Dry				Stagnant				L				M				H								

**SUBSTRATE (add to 100%) - pg. 22****INSTREAM COVER - pg. 23**

Boulder - 10 in. diam. Cobble/Gravel - 10 to .08 in. diam. Sand - coarse grain Silt/Detritus/Muck - fine grain/organic matter Hardpan/Bedrock - solid clay/rock surface Artificial - manmade Unknown	U/S (%)		D/S (%)		Undercut Banks Overhanging Veg. Deep Pools Boulders Aquatic Plants Logs or Woody Debris	U/S (x)		D/S (x)	

**RIVER MORPHOLOGY - pg. 23****STREAM CORRIDOR - pg. 26**

Riffle	U/S		D/S		Riparian Veg. Width ft.(L)	U/S				D/S			
	Present	Abundant	Present	Abundant		< 10	10-30	30-100	>100	< 10	10-30	30-100	>100
Pool	Present	Abundant	Present	Abundant	Riparian Veg. Width ft.(R)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100
Channel	Natr	Recv	Maintr	d	Bank Erosion	0	L	M	H	0	L	M	H
Designated Drain	?	Y	N		Streamside Land Cover	B	G	S	T	B	G	S	T
					Stream Canopy %	<25	25-50	> 50		<25	25-50	> 50	

Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

**Stream Cross Section****Adjacent Land Uses**

Wetlands	L		R		L	R
Shrub or Old Field	L	R	L	R	L	R
Forest	L	R	L	R	L	R
Pasture	L	R	L	R	L	R
Crop Land	L	R	L	R	L	R
Animal Feeding Operation	L	R	L	R	L	R
Maintained Lawns/Parks	L	R	L	R	L	R
Impervious Surfaces	L	R	L	R	L	R
Disturbed Ground	L	R	L	R	L	R
No Vegetation	L	R	L	R	L	R

Date:

**Watershed Survey Data Sheet (pg. 2)**

Station #:

**ROAD CROSSING INFORMATION**

<b>Crossing Type</b>	<b>Bridge</b>	<b>Round Culvert(s)</b>	<b>Box Culvert(s)</b>	<b>Arch Culvert(s)</b>	<b>Other:</b>			
<b>Road Surface</b>	<b>Paved</b>	<b>Gravel</b>	<b>Sand</b>	<b>Clay</b>	<b>Grass</b>	<b>Other:</b>		
<b>Road Ownership</b>	<b>MDOT</b>	<b>County</b>	<b>USFS</b>	<b>MDNR</b>	<b>Municipal</b>	<b>Priv/Corp</b>	<b>Unknown</b>	<b>Other:</b>
<b>Culvert Problems</b>	<b>Poor Alignment</b>	<b>Inadequate Armoring</b>	<b>Impounding Water</b>	<b>Obstructed</b>	<b>Structural Integrity</b>	<b>Other:</b>		
<b>Perched Culvert</b>	<b>&lt; 3"</b>	<b>3-12"</b>	<b>&gt; 12"</b>	<b>Plunge Pool</b>				
<b>Crossing Erosion</b>	<b>Crossing Embankment</b>	<b>Road Approaches</b>	<b>Road Ditches</b>					

**POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28**

	U/S			D/S				U/S			D/S		
<b>Crop Related Sources</b>	S	M	H	S	M	H	<b>Land Disposal</b>	S	M	H	S	M	H
<b>Grazing Related Sources</b>	S	M	H	S	M	H	<b>On-site Wastewater Systems</b>	S	M	H	S	M	H
<b>Intensive Animal Feeding Operations</b>	S	M	H	S	M	H	<b>Silviculture (Forestry NPS)</b>	S	M	H	S	M	H
<b>Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)</b>	S	M	H	S	M	H	<b>Resource Extraction (Mining NPS)</b>	S	M	H	S	M	H
<b>Channelization</b>	S	M	H	S	M	H	<b>Recreational/Tourism Activities (general)</b>	S	M	H	S	M	H
<b>Dredging</b>	S	M	H	S	M	H	• <b>Golf Courses</b>	S	M	H	S	M	H
<b>Removal of Riparian Vegetation</b>	S	M	H	S	M	H	• <b>Marinas/Recr. Boating (water releases)</b>	S	M	H	S	M	H
<b>Bank and Shoreline Erosion/Modification/Destruction</b>	S	M	H	S	M	H	• <b>Marinas/Recr. Boating (bank or shoreline erosion)</b>	S	M	H	S	M	H
<b>Flow Regulation/Modification (Hydrology)</b>	S	M	H	S	M	H	<b>Debris in Water</b>	S	M	H	S	M	H
<b>Upstream Impoundment</b>	S	M	H	S	M	H	<b>Industrial Pt. Source</b>	S	M	H	S	M	H
<b>Construction: Highway/Road/Bridge/Culvert</b>	S	M	H	S	M	H	<b>Municipal Pt. Source</b>	S	M	H	S	M	H
<b>Construction: Land Development</b>	S	M	H	S	M	H	<b>Natural Sources</b>	S	M	H	S	M	H
<b>Urban Runoff (Residential/Urban NPS)</b>	S	M	H	S	M	H	<b>Source(s) Unknown</b>	S	M	H	S	M	H

**SITE SUMMARY INFORMATION – pg. 33**

<b>SURVEY DIRECTION</b>	N/A	U/S	D/S
<b>SITE SIMILARITY</b>	?	Y	N
<b>OVERALL SITE RANKING</b>	Good	Fair	Poor
<b>FOLLOW UP</b>	L	M	H

COMMENTS:

## Appendix 4.1 - Designated Uses

### Buck Creek Watershed

14 93 Agricultural and suburban  
14 94 Industrial and residential

Designated Use	Being Met	Threatened	Impaired	Pollutants	Source	Causes
<b>Agriculture</b>	Yes					
<b>Navigation</b>	Not a use					
<b>Industrial Use</b>	Yes					
<b>Coldwater Fishery</b>		Temperature might pose a threat		Temperature (s)	Urban runoff (s)	Increased imperviousness (s)
		Road salt might pose a threat		Road salt (s)	Urban runoff (k)	Misapplication or over-application of road salt (s)
			North of 84th Street to limits of City of Grandville moderately impaired.	Nutrients (k)	Yard waste (k)	Illegal dumping on streambanks (k)
			North of 84th Street to limits of City of Grandville moderately impaired. Severely impaired in Lemery Park and Burlingame Avenue areas.	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)
					Construction site runoff (k)	Lack of SESC measures (s)
<b>Coolwater Fishery</b>		Temperature might pose a threat		Temperature (s)	Urban runoff (s)	Increased imperviousness (s)
		Road salt might pose a threat		Road salt (s)	Urban runoff (k)	Misapplication or over-application of road salt (s)
			City of Grandville moderately impaired	Nutrients (k)	Yard waste (k)	Illegal dumping on streambanks (k)
			City of Grandville moderately impaired	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)
					Construction site runoff (k)	Lack of SESC measures (s)
<b>Warmwater Fishery</b>			Slightly to moderately impaired south of 84th Street	Sediment (k)	Streambank erosion (k)	Fluctuating hydrology (k)
					Construction site runoff (s)	Lack of SESC measures (s)
					Agricultural runoff (s)	Conventional tillage, plowing up to edge of stream, lack of buffer (s)
			Slightly to moderately impaired south of 84th Street	Nutrients (k)	Yard waste (k)	Illegal dumping on streambanks (k)
					Agricultural runoff (s)	Conventional tillage, plowing up to edge of stream, lack of buffer (s)
		Road salt might pose a threat		Road salt (s)	Urban runoff (k)	Misapplication or over-application of road salt (s)
<b>Other Indigenous Aquatic Life and Wildlife</b>			Habitats are moderately to severely impaired	Sediment (k)	Storm water runoff scouring streambed (k)	Increased imperviousness (s)
<b>Partial Body Contact Recreation</b>			Fishing and other recreational opportunities are impaired	Pathogens ( <i>E. coli</i> ) (k)	Failing septic systems (s), TMDL to be determined by 2006	Leaking, poorly maintained, and over capacity septic systems (s)
					Urban wildlife populations (s)	Overpopulations in urban areas (s)
					Pet waste (s)	Uncollected waste (s)
<b>Total Body Contact Recreation</b>			Swimming (wading at Palmer Park) is impaired	Pathogens ( <i>E. coli</i> ) (k)	Failing septic systems (s), TMDL to be determined by 2006	Leaking, poorly maintained, and over capacity septic systems (s)
					Urban wildlife populations (s)	Overpopulations in urban areas (s)
					Pet waste (s)	Uncollected waste (s)
<b>Public Water Supply</b>	Not a use					

Source: MDEQ Biological surveys

(k) = known

(s) = suspected

BEST MANAGEMENT PRACTICES		BMP Links (Must Be Connected to the Internet)	
MDEQ NPS BMP INDEX		<a href="http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3714-13186--,00.html">http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3714-13186--,00.html</a>	
Access Road		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-ar.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-ar.pdf</a>	
Buffer/ Filter Strip		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-bfs.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-bfs.pdf</a>	
Catch Basins		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-cab.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-cab.pdf</a>	
Critical Area Stabilization		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-cas.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-cas.pdf</a>	
Community Car Washes		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-car.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-car.pdf</a>	
Check Dam		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-cd.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-cd.pdf</a>	
Construction Barrier		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-cob.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-cob.pdf</a>	
Constructed Wetlands		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-conw.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-conw.pdf</a>	
Dust Control		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-dc.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-dc.pdf</a>	
Diversions		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-div.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-div.pdf</a>	
Dune/ Sand Stabilization		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-dss.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-dss.pdf</a>	
Dewatering		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-dw.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-dw.pdf</a>	
Extended Detention Basin		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-edb.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-edb.pdf</a>	
Equipment Maintenance And Storage Area		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-ems.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-ems.pdf</a>	
Filters		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-fil.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-fil.pdf</a>	
Fertilizer Management		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-fm.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-fm.pdf</a>	
Grading Practices		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-gp.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-gp.pdf</a>	
Grade Stabilization Structures		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-gss.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-gss.pdf</a>	
Grassed Waterways		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-gw.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-gw.pdf</a>	
Household Hazardous Waste Disposal		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-hhww.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-hhww.pdf</a>	
Infiltration Basin		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-ib.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-ib.pdf</a>	
Infiltration Trench		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-it.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-it.pdf</a>	
Land Clearing		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-lc.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-lc.pdf</a>	
Lawn Maintenance		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-lm.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-lm.pdf</a>	
Modular Pavement		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-mp.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-mp.pdf</a>	
Mulching		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-mul.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-mul.pdf</a>	
Organic debris Disposal		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-odd.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-odd.pdf</a>	
Oil Grit Separators		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-ogs.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-ogs.pdf</a>	
Porus Asphalt Pavement		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-pap.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-pap.pdf</a>	
Pond Construction and Management		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-pcm.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-pcm.pdf</a>	
Parking Lot Storage		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-pls.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-pls.pdf</a>	
Pesticide Management		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-pm.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-pm.pdf</a>	
Pond Sealing and Lining		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-ps.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-ps.pdf</a>	
Riprap		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-rip.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-rip.pdf</a>	
Roof Top Storage		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-rtb.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-rtb.pdf</a>	
Sediment Basin		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sb.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sb.pdf</a>	
Streambank Stabilization		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sbs.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sbs.pdf</a>	
Storm Water Conveyance Channel		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-scc.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-scc.pdf</a>	
Subsurface Drain		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sd.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sd.pdf</a>	
Seeding		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-see.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-see.pdf</a>	
Soil Management		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sm.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sm.pdf</a>	
Stabilized Outlet		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-so.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-so.pdf</a>	
Sodding		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sod.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sod.pdf</a>	
Spoil Piles		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sp.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sp.pdf</a>	
Staging and Scheduling		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-ss.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-ss.pdf</a>	
Slope/ Shoreline Stabilization		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sss.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sss.pdf</a>	
Street Sweeping		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-sw.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-sw.pdf</a>	
Tree Protection		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-tp.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-tp.pdf</a>	
Water Course Crossing		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-wac.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-wac.pdf</a>	
Wet Detention Basin		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-wdb.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-wdb.pdf</a>	
Wet Land Crossing		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-wec.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-wec.pdf</a>	
Winter Road Maintenance		<a href="http://www.deq.state.mi.us/documents/deq-swq-nps-wrm.pdf">http://www.deq.state.mi.us/documents/deq-swq-nps-wrm.pdf</a>	

URBAN STRUCTURAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
PRETREATMENT (ex. Sediment traps, drainage channels, water quality inlets)														
Hydrodynamic Separator Units (CDS Units, Stormceptors, Vortechincs, Downstream Defender)	Sediment, oils, solids	Effective	Storm sewer system		50+	Moderate	Minimum	Widely applicable - underground unit		Catches first flush, high flows by-pass unit through pipe system		General fund	Placed upstream of storm sewer discharge into lake. Also, unit is below grade. Needs to allow for access for cleaning the chambers.	East Grand Rapids
Catch basin inlet devices	Solids, sediments	Moderate to high	Stormwater runoff	Catch basin cleaning program	Short	High	Low/moderate	Needs less than 5 acres of drainage area		Lack of maintenance can lead to flooding if catch basin clogs	Low		Useful for retrofit	MDOT
Permanent Sediment Basin														
Combination curb with water spreader														
Check dams, Grade control structures														
DETENTION/RETENTION (ex. Extended detention basin)														
Ponded Type Detention Basin	Sediment	Moderate	Stormwater runoff		20+ years	Low	Minimum	Widely applicable, larger drainage areas (10+ acres)	Possible downstream warming; low bacteria removal	Reduced peak flows, storage, West Nile Virus	Low to moderate	General fund	Need available land area, design standards, can include sediment forebay.	East Grand Rapids, OCRC
Dry Detention Basin	Sediment	Moderate	Stormwater runoff		50+ years	Low	Moderate	Needs land that will allow inlet at a higher elevation than outlet	Low bacteria and nutrient removal. If vegetation is not maintained erosion and resuspension will occur.	Reduced peak flows and no standing water	Low to moderate		Hard to establish vegetation	MDOT, OCDC
Regional Detention														OCDC
VEGETATED TREATMENT (ex. Constructed wetland, grassed swale)														
Constructed Wetland	Sediment, nutrients, bacteria	Moderate to high depending on season	Stormwater runoff		50+ years	Low	Moderate to High	Needs large land area with appropriate soils and slope	Potential for nutrient release in winter months	Slows flow and reduces peak flow	High		2% of drainage area needs to be wetland for efficient pollutant removal. Harvesting may be necessary if plants are uptaking large amounts of toxics	MDOT
Wooded Buffers	Thermal pollution	Moderate to high	Runoff from parking lots and roof tops and outflow from ponds		50+ years	Low	Moderate to High	Widely applicable	Lack of maintenance can increase erosion if trees fall into streams	Trees in floodplain can impede flow	Moderate to high		At minimum keep south and west sides of streams wooded to provide shade	
INFILTRATION (ex. Infiltration basin)														
Infiltration Trench	Nutrients, sediment, metals	High	Stormwater runoff		Short (10 years or less)	Annual	Moderate	Site specific depends on soils	Potential to contaminate groundwater		Moderate		Avoid areas with potential hazardous material contamination	MDOT
Infiltration Pond	Nutrients, sediment, metals	High	Stormwater runoff		25 years	Annual	Moderate	Site specific depends on soils	Potential to contaminate groundwater		Moderate		Avoid areas with potential hazardous material contamination	MDOT
Porous Pavement	Nutrients, sediment, metals	High	Stormwater runoff		Varies	Moderate		Not suited for high traffic areas	Potential to contaminate groundwater		Moderate		Avoid areas with potential hazardous material contamination	MDOT
FILTRATION (ex. Sand filters)														
Vegetated Swale or Bio-filtration	Sediment and Metals	High	Stormwater runoff		20-50 years	Moderate	Moderate	Highly applicable to residential areas, not suited to steep slopes	Potential to contaminate groundwater and does not remove nutrients	Slows flow	Low		Does not require a large land area. Should not be used in steep areas or well head areas	MDOT
Sand Filters	Sediment, Bacteria, Nutrients, Metals	Moderate	Stormwater runoff		Yet to be determined	Moderate to high depending on amount of sediment	Moderate		Will not filter soluble nutrients and toxics		Low to moderate		BMP performance is still experimental	

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Pollution Prevention																
Planning and zoning																
SESC plans																
Dust Control (MDEQ)	Prevents soils and attached chemicals, such as fertilizer and pesticides, from entering surface waters.	Silt and clay		Lack of vegetation	Mulching, permanent vegetative cover.					Rural, urbanizing, and transportation sites subject to wind erosion						
Encourage stream protection when siting developments																
Site planning																
Green space protection - preserving environmentally sensitive and open areas																Ottawa County Parks and Recreation Commission, Land Conservancy of West Michigan
Emergency Spill Response and Prevention Plan	Can be highly effective at reducing the risk of surface and groundwater contamination.	Hazardous Wastes	Low to high, depending on preparedness		Training		Plan needs to be updated		Moderate						Speed and containment are critical. Requires a well-planned and clearly defined plan. May require training. Equipment must be readily available. (MDOT)	Ottawa County, MDOT
Identify and prohibit illegal or illicit discharges to storm drains (MDOT)	Eliminate hazardous and harmful discharges.							\$0.83/acre/year \$50/ac/yr (with TV inspection)					\$2/ac (assuming 1 system monitored every 5 sq. miles)			Phase II communities, MDOT
Litter Control (MDOT)	Reduce potential clogging. Proper disposal of paper, plastic, and glass.							\$16/acre/year					\$20/trash can			MDOT
"No Littering" Ordinance (MDOT)	Prevents litter from entering storm drain.							Potentially self-supporting					\$20,000			
Fertilizer Ordinance - fertilizers containing more than 1% by weight of anhydric phosphoric acid are NOT allowed in the Reeds Lake Watershed.		Phosphorus		Fertilizers			High		Low/moderate	Widely applicable to drainage area	Reduces amount of phosphoric acid in the watershed		High	Costs assessed to resident	Locations of fertilizers are few	East Grand Rapids
Material Management Plan (MDOT)	Identified hazardous and non-hazardous materials in the facility. Ensures that all containers have labels. Identifies hazardous chemicals that require special handling, storage, and disposal.															MDOT
Household hazardous waste management																
Composting																Ottawa County
Yard waste collection and disposal		Nutrients and organic sediment	High	Yard waste and leaf litter	Composting of collected refuse		Compost application, sale, and delivery		Minimal	Widely applicable to dense residential or riparian sites	Waste needs to be composted and correctly applied as fertilizer		Low		Need large collection facility for compost operations	Cascade Township, City of Wyoming, City of Kentwood, City of Grand Rapids, Byron Township, Ada Township, City of Coopersville, Georgetown Twp

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Pesticide management for turf grass and ornamentals																
Lawn maintenance																
Fertilizer management																
Pet waste disposal																
Street Sweeping	Reduction in potential clogging of storm drain material. Some oil and grease control (MDOT).	Sediment, metals, hydrocarbons	Moderate	Atmospheric, construction, vehicles	Vehicle maintenance and sweeping schedules				Moderate		Sweeping may wash sediments into catch basins if wash is not vacuumed		Moderate to High	KCRC Road maintenance budget - \$300,000/yr Ottawa County Local units	Disposal of collected materials must be handled by the governing agency (MDEQ, Public Health, Transportation.) Timing critical - sweep after snow melt and before spring rains	City of East Grand Rapids, Cascade Township, City of Wyoming, City of Kentwood, Gerald R. Ford International Airport - Mostly contracted out to Sanisweep by KCRC, MDOT
Sidewalk Cleaning (MDOT)	Reduction of material entering storm drain.							\$60/acre/year								
Clean and maintain storm drain channels (MDOT)	Prevent erosion in channels. Improve capacity by removing sediment. Remove debris toxic to wildlife.							\$21/acre/year								MDOT
Clean and maintain storm inlets and catch basins (MDOT)	Removes sediment. May prevent local flooding.	Solids, sediments	Moderate	Stormwater runoff		1 - 3 years	High	\$21/acre/year	Low/moderate	Widely applicable to drainage area			Moderate/high	General fund, KCRC road maintenance budget - \$250,000		East Grand Rapids, KCRC contracts out to Plummer's Environmental, MDOT
Snow and ice control operations	Removes snow and ice before it requires ice control operations (MDOT).	Salts	High	Snow melt runoff	Training of road maintenance crew		Calibration of equipment		Moderate, all KCRC equipment operators are trained.	Need ROW for snow removal	Snow storage may damage vegetation and possible soil erosion	Piled snow melts at a slower rate	Low	KCRC winter maintenance budget - \$3.5 million	KCRC maintains State trunk lines for Michigan Department of Transportation (MDOT), primary, local and gravel roads within Kent County. Subdivisions and Platted areas contracted out.	KCRC, MDOT
Calibrated Salt Delivery		Salts	Low	Over application of salt	Training of road crew		Annual training and calibration		Minimal	Applicable to all municipalities	Calibration does not guarantee efficient application of road salt		Low			Wyoming, KCRC
Pre wet road salt				Road salt	Environmentally friendly "Ice Ban"		Low		Minimal				Low/Moderate	General fund		East Grand Rapids
Snow removal storage on grassy areas		Sediment, metals, hydrocarbons, salt	Low	Snow melt runoff			Low		Minimal	Applicable to all municipalities	Snow storage may damage vegetation and possible soil erosion		Low	General fund	Need large grassed area adjacent to buildings and parking areas	City of Grandville
Minimizing effects from road deicing (MDOT)																MDOT
Clean and inspect debris basin (MDOT)	Flood control, proper drainage and preventing flooding.							\$21/acre/year								
Recycling Program (MDOT)	Reduction in potential clogging and harmful discharge.							\$1.15/person/year					\$200,000/year			



URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Used oil recycling program (MDOT)	Reduces risk of surface water and groundwater contamination.										Oil may easily become contaminated during collection making it a hazardous waste.		\$79 - \$179 recovery charge			MDOT
Annual Road/Crossing Inspections		Sediment	Moderate	Erosion of streambank	Training and road crossing improvements		Moderate		Low/moderate				Moderate	Assessment		Coopersville
Operation and maintenance programs																
BMP Inspection and Maintenance Plan (MDOT)	A regular inspection and maintenance program will maintain the effectiveness and structural integrity of the BMPs.												\$150-\$9,000 depending on the BMP.		Materials needed for emergency structural repairs may not be easily obtainable and may require stockpiling (MDOT)	MDOT
Source Control Practices																
Establish stream buffer ordinance		Thermal pollution	Moderate to high	Runoff from parking lots and roof tops and outflow from ponds		50+ years	Low		Moderate to High	Widely applicable	Lack of maintenance can increase erosion if trees fall into streams	Trees in floodplain can impede flow	Moderate to high		At a minimum, keep south and west sides of streams wooded to provide shade	
Promote urban forestry																
Onsite impervious surfaces																
Green Parking (MDOT)	Promotes infiltration and filtering of storm water.												High		This BMP is experimental for MDOT until proven valuable and cost effective	MDOT
Residential impervious surfaces							High			Experimental						
Rain gardens																
Low Impact Design practices - bioretention, dry wells, filter strips, vegetated buffers, grass swales, rain barrels, cisterns, infiltration trenches																
Education and Training Practices																
Public Education (MDOT)	Can reduce improper disposal of hazardous waste.							\$257,000/year					\$200,000/year			
Grounds maintenance training		Nutrients and organic sediment	Moderate	Leaf litter, grass clippings, fertilizer, and pesticides			Annual		Low	Highly			Low	General fund		Cascade Township, City of Grandville, City of Grand Rapids
Employee Training (MDOT)	Low cost and easy to implement storm water management BMPs.															MDOT
Lawn, garden, and landscape activities																

URBAN MANAGERIAL BEST MANAGEMENT PRACTICES

BEST MANAGEMENT PRACTICES	BENEFIT	POLLUTANT ADDRESSED	POLLUTANT REMOVAL RELIABILITY	POTENTIAL SOURCES OF POLLUTANTS	ADDITIONAL BMPS TO COMPLETE TREATMENT TRAIN	EXPECTED LIFE SPAN	MAINTENANCE REQUIREMENTS	O&M COSTS	TRAINING REQUIREMENTS	APPLICABILITY TO SITE	ENVIRONMENTAL CONCERNS	HYDROLOGIC EFFECTS TO CONSIDER	COMPARATIVE COSTS	FUNDING SOURCES	SPECIAL CONSIDERATIONS	COMMUNITIES USING BMP
Storm Drain Stenciling	Educates the general public that the storm drain discharges into a natural waterbody.	Hazardous waste and nutrients	Moderate	Household hazardous waste, motor oil, and yard waste	Hazardous waste collection, yard waste collection	Short	Paint will wear from weather in a short period of time. Decals may need to be replaced if vandalized or improperly installed.		Minimal	Residential	Volunteers need to take care with paint around storm drains. Permanent castings may be more effective.		\$0.45/inch - Mylar stencils \$5-\$6 each - ceramic tiles \$100 or more - metal stencils	Private donations and grants	Public education campaign is also needed for effective reduction in illegal dumping.	East Grand Rapids, MDOT, Spring Lake Lake Board
Preservation and Conservation Practices																
Native Plantings		Pesticides, nutrients	Moderate	Fertilizers, pesticides, lawn waste	Training of road and grounds maintenance crew		Low		Moderate	Increase in animal/car collision			Low	General fund		City of Grand Rapids
Tree and natural resource preservation ordinances																
Non-regulatory wetland protection techniques																
Land donations	Most direct and cost-effective method of protecting wetlands.															
Conservation Easements	Voluntary agreement that is used to transfer certain rights to another party.															
Deed restrictions and Covenants	Clauses placed in deeds restricting future use of land.															
Purchase	Politically attractive, but expensive method of protecting wetlands.															
Eminent domain	Power of federal, state, or local municipal government to take private property for public use.															
Tax incentives	tax reductions for short-term wetland "easements" to encourage landowners to protect wetlands.															
Private landowner subsidies	Programs that pay landowners to protect wetlands.															
Designing development to protect wetlands																
Open space development																
Cluster development																

## Appendix 6.4 - Structural Best Management Practice Worksheet

### Worksheet for Evaluating Urban Best Management Measures

Urban Subcommittee

Lower Grand River Watershed

		Downtown	Residential	Residential	Residential	Industrial	Commercial	Residential	Open Space
	Recommended Management Measures	85% impervious	3 - 5 feet of grass between road and sidewalk	10 - 12 feet of grass between road and sidewalk	Vacant grassed lot	Vacant paved lot	Paved parking lot	Large lots, rural, private condominiums	Farmland, idle
1	Catch Basin Inlet Devices - temporary and permanent								
2	Trees (appropriate tree species and size for each site)								
3	Infiltration Trench			Private					
4	Porous Pavement (Parking lots or sidewalks)								
5	Infiltration Pond								
6	Bioretention (Rain Gardens)								
7	Vegetated Swale						with rain gardens		
8	Ponded Type Detention Basin								
9	Dry Pond (Detention Basin)								
10	Hydrodynamic Separator Units (CDS Units, Stormceptor, Vortechs, Downstream Defender)								
11	Regional Detention Pond (high water quality) - Regional Storm Water Management (basin, wetland, sediment basin)								
12	Daylighting								
13	Constructed Wetland								
14	Permanent Sediment Basin								
15	Check dams, grade control structures								
16	Wooded buffers								
17	Street Maintenance and Street Cleaning								
18	Green Roofs								
19	Sand Filters								

## Appendix 6.5 - Structural Best Management Practice Nonpoint Source Removal Efficiency

Urban Subcommittee  
Lower Grand River Watershed

	Recommended Management Measures	Pollutant Removal Efficiencies					
		Total Phosphours	Total Nitrogen	Total Suspended Solids (TSS)	Metals	Bacteria	Oil and Grease
1	Catch Basin Inlet Devices - temporary and permanent		30% - 40% sand filters	30% - 90%			
2	Trees (appropriate tree species and size for each site)						
3	Infiltration Trench	50%- 100%	43% - 100%	50% - 100%			
4	Porous Pavement (Parking lots or sidewalks)						
5	Infiltration Pond	60% - 100%	50% - 100%	50% - 100%	85% - 90%	90%	
6	Bioretention (Rain Gardens)	65% - 98%	49%	81%	51%-71%		
7	Vegetated Swale	15% - 77%	15% - 45%	65% - 95%	14% - 71%	(-50%) - (-25%)	with rain gardens
8	Ponded Type Detention Basin	48% - 90%	31% - 90%	29% - 73%	38% - 100%	66%	
9	Dry Pond (Detention Basin)						
10	Hydrodynamic Separator Units (CDS Units, Stormceptor, Vortechs, Downstream Defender)						
11	Regional Detention Pond (high water quality) - Regional Storm Water Management (basin, wetland, sediment basin)						
12	Daylighting						
13	Constructed Wetland	39% - 83%	56%	69%	(-80%) - 63%	76%	
14	Permanent Sediment Basin			65%			
15	Check dams, grade control structures						
16	Wooded buffers	23% - 42%	85%				
17	Street Maintenance and Street Cleaning						
18	Green Roofs	70% - 100% reduction in runoff, 40% - 50% of winter rainfall, 60% temperature reduction					
19	Sand Filters	41% - 84%	22% - 54%	63% - 109%	26% - 100%	(-23%) - 98%	

## Appendix 6.6 - Managerial Best Management Practice Worksheet

### Worksheet for Evaluating Managerial Best Management Practices

Urban Subcommittee

Lower Grand River Watershed

	Downtown	Residential	Residential	Industrial	Commercial	Subcommittee Priorities
MANAGERIAL BEST MANAGEMENT PRACTICES	85% impervious	High to medium density	Low density to open space	Vacant paved lot	Paved parking lot	
<b>Pollution Prevention</b>						
Planning and zoning						
SESC plans	During development					
Encourage stream protection when siting developments						
Site planning						
Green space protection - preserving environmentally sensitive and open areas						
Emergency Spill Response and Prevention Plan						
Identify and prohibit illegal or illicit discharges to storm drains (MDOT)						
Litter control (MDOT)						
"No Littering" Ordinance (MDOT)						
Fertilizer Ordinance - fertilizers containing more than 1% by weight of anhydric phosphoric acid are NOT allowed in the Reeds Lake Watershed						
Material Management Plan (MDOT)						
Household hazardous waste management						
Composting						
Yard waste collection and disposal						
Pesticide management for turf grass and ornamentals						
Lawn maintenance						
Fertilizer management						
Pet waste disposal						
Street Sweeping						

## Appendix 6.6 - Managerial Best Management Practice Worksheet

	Downtown	Residential	Residential	Industrial	Commercial	Subcommittee Priorities
MANAGERIAL BEST MANAGEMENT PRACTICES	85% impervious	High to medium density	Low density to open space	Vacant paved lot	Paved parking lot	
Clean and maintain storm drain channels (MDOT)						
Clean and maintain storm inlets and catch basins (MDOT)						
Snow and ice control operations						
Calibrated salt delivery						
Pre wet road salt						
Snow removal storage on grassy areas						
Minimizing effects from road deicing (MDOT)						
Clean and inspect debris basin (MDOT)						
Recycling program (MDOT)						
Used oil recycling program (MDOT)						
Annual road/crossing inspections						
BMP Inspection and Maintenance Plan (MDOT)						
<b>Source Control Practices</b>						
Establish stream buffer ordinance						
Promote urban forestry						
Onsite pervious surfaces						
Green parking (MDOT)						
Residential pervious surfaces						
Rain gardens						

## Appendix 6.6 - Managerial Best Management Practice Worksheet

	Downtown	Residential	Residential	Industrial	Commercial	Subcommittee Priorities
MANAGERIAL BEST MANAGEMENT PRACTICES	85% impervious	High to medium density	Low density to open space	Vacant paved lot	Paved parking lot	
Low Impact Design practices - bioretention, dry wells, filter strips, vegetated buffers, grass swales, rain barrels, cisterns, infiltration trenches						
<b>Education and Training Practices</b>						
Public 3education (MDOT)						
Grounds maintenance training						
Employee training (MDOT)						
Lawn, garden, and landscape activities						
Storm drain stenciling						
<b>Preservation and Conservation Practices</b>						
Native plantings						
Tree and natural resource preservation ordinances						
Non-regulatory wetland protection techniques						
Land donations						
Conservation easements						
Deed restrictions and covenants						
Purchase						
Eminent domain						
Tax incentives						
Private landowner subsidies						
Designing development to protect wetlands						
Open space development						
Cluster development						



## Appendix 9.1 - Target Audience Profiles

Target Audience: Urban Pilot Project Areas

1. What is the makeup of the target audience?
  - b. Average Age Varied Families
  - c. Gender M & F
  - d. Place of Residents (home or apartment, any unique characteristics)  
Population : 474,296 ; Owner Occupied Housing Units: 118,816; Renter Occupied Housing Units: 59,173
  - e. Level of Education: 87.67% have high school education or higher
  - f. Level of Income: median family income \$60,619.00

➤ Other pertinent facts: 39.05% of families have children under 18
2. How do they communicate with each other? Grand Rapids Press, Grand Rapids Times, Grand Rapids Business Update, Paper, On-The-Town Magazine, Community Voice, Ottawa Press, West Michigan Christian Newspaper, Associated Press, Michigan Outdoor News, Catholic Connector, The Holland Sentinel, West Michigan Today, Alive, mlive, Bulletin Boards, Church newsletters, Restaurants
3. How do they receive information on environmental issues? Mass Media and possibly through organizations active in the area.
4. Of what other community organizations are they members? Timberland Resource Conservation & Development Area Council, American Legion, Girl Scouts of Michigan Trails, Boy Scouts of America, UAW-United Automobile, Aerospace & Agricultural Implement Workers of America, Rotary Club of Grand Rapids, Kent County Conservation League, Kent County Farm Bureau, Marne Conservation Club, Land Conservancy of West Michigan, West Michigan Alive, The Nature Conservancy, Isaac Walton League, Trout Unlimited, Ducks Unlimited
5. What are their major environmental concerns: \_\_\_\_\_

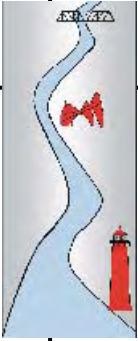


**Urban Pilot Project Area**  
**General Demographic Profile**  
**Using Demographic Profile 1 (DP-1) Profile of General Characteristics: 2000**  
**DP-2 Profile of Selected Social Characteristics: 2000**  
**DP-3 Profile of Selected Economic Characteristics: 2000**  
**Geographic Comparison Table-Population Housing (GCT-PHI) Population,**  
**Housing, Area, and Density: 2000**

Using the United States Census Bureau, American FactFinder,  
[www.factfinder.census.gov](http://www.factfinder.census.gov)

Information was collected from above sources for the following Minor Civil Divisions (MCD): Alpine Township, Kent County; Byron, Kent County; Dorr, East Grand Rapids, Kent County; Gaines, Kent County; City of Grand Rapids, Kent County; Grand Rapids Charter, Kent County; City of Grandville, Kent County; City of Kentwood, Kent County; Leighton, Allegan; Plainfield, Kent County; Tallmadge, Ottawa County; City of Walker, Kent County; City of Wyoming, Kent County;

- Total Population: 474,296
- Female Population: 241,560
- Male Population: 232,736
- Average Water Area/square mile/MCD: 0.33
- Total Water Area/square mile: 4.67
- Average Population Density/square mile of land use/ MCD: 1,419
- Average Housing Unit Density/square mile of land use/MCD: 553
- Number of Owner Occupied Housing Units: 118,816
- Number of Renter Occupied Housing Units: 59,173
- Median Household Income/MCD: \$52,630.21
- Median Family Income/MCD: \$60,619.00
- Average % of Families with Children under 18/MCD: 39.05%
- Average % Have high school education or up/MCD: 87.67%
- Average % have BA or higher/MCD: 25.84%
- Average % have only high school: 30.30%



## Lower Grand River Watershed Project

### Target Audience Profile

Target Audience: Agricultural Community

1. What is the makeup of the target audience (answer if appropriate) ?
  - a. Average Age N/A
  - b. Gender N/A
  - c. Place of Residents (home or apartment, any unique characteristics)  
Homes in watershed
  - d. Level of Education: N/A
  - e. Level of Income: refer to following table
  - f. Other pertinent facts: Major crops for Kent County are corn, oats, and soybeans
2. How do they communicate with each other? Michigan State University Extension, Farm Bureau, Natural Resource Conservation District, Natural Resource Conservation Service, Internet, 4-H fairs
3. How do they receive information on environmental issues? Mass Media, local publications, small group discussions.
4. Of what other community organizations are they members? Churches, sporting clubs
5. What are their major environmental concerns: Flooding, water storage, dredging of drains (sedimentation)

# Target Audience Profile

Target Audience: Agricultural Community, Extra Information

Agricultural Census Information for Kent County, Michigan			
	1997	1992	1987
Farms (number)	1,136	1,190	1,368
Land in farms (acres)	186,453	190,706	203,842
Land in farms - average size of farm (acres)	164	160	149
Land in farms - median size of farm (acres)	63	(N)	(N)
Estimated market value of land and buildings@1: average per farm (dollars)	453,387	301,712	202,820
Estimated market value of land and buildings@1: average per acre (dollars)	2,686	1,832	1,274
Estimated market value of all machinery/equipment@1: average per farm (dollars)	74,189	59,263	42,890
Farms by size: 1 to 9 acres	97	97	126
Farms by size: 10 to 49 acres	383	347	430
Farms by size: 50 to 179 acres	399	470	489
Farms by size: 180 to 499 acres	178	196	234
Farms by size: 500 to 999 acres	45	52	62
Farms by size: 1,000 acres or more	34	28	27
Total cropland (farms)	1,043	1,113	1,268
Total cropland (acres)	149,898	154,552	163,275
Total cropland, harvested cropland (farms)	934	1,046	1,175
Total cropland, harvested cropland (acres)	127,476	119,403	121,233
Irrigated land (farms)	128	164	144
Irrigated land (acres)	6,120	9,030	7,445
Market value of agricultural products sold (\$1,000)	121,041	105,990	82,983
Market value of agricultural products sold, average per farm (dollars)	106,550	89,067	60,660
Market value of ag prod sold - crops, incl nursery and greenhouse crops (\$1,000)	91,987	73,688	50,383
Market value of ag products sold - livestock, poultry, and their products (\$1,000)	29,054	32,302	32,600
Farms by value of sales: Less than \$2,500	309	325	397
Farms by value of sales: \$2,500 to \$4,999	152	139	163
Farms by value of sales: \$5,000 to \$9,999	127	157	196
Farms by value of sales: \$10,000 to \$24,999	158	161	188
Farms by value of sales: \$25,000 to \$49,999	87	99	105
Farms by value of sales: \$50,000 to \$99,999	89	96	108
Farms by value of sales: \$100,000 or more	214	213	211
Total farm production expenses@1 (\$1,000)	93,300	88,084	66,289
Total farm production expenses@1, average per farm (dollars)	82,131	74,082	48,421
Net cash return from agricultural sales for the farm unit (see text)@1 (farms)	1,136	1,189	1,369
Net cash return from agricultural sales for the farm unit (see text)@1 (\$1,000)	27,844	19,863	16,075
Net cash return from ag sales for fm unit (see text)@1, average per farm (dollars)	24,510	16,705	11,742

Operators by principal occupation: Farming	487	536	625
Operators by principal occupation: Other	649	654	743
Operators by days worked off farm: Any	667	701	809
Operators by days worked off farm: 200 days or more	501	531	610
Livestock and poultry: Cattle and calves inventory (farms)	356	431	531
Livestock and poultry: Cattle and calves inventory (number)	27,633	32,184	34,672
Beef cows (farms)	189	184	227
Beef cows (number)	2,769	2,327	3,286
Milk cows (farms)	93	148	173
Milk cows (number)	9,097	11,218	12,343
Cattle and calves sold (farms)	336	391	519
Cattle and calves sold (number)	11,272	13,420	17,002
Hogs and pigs inventory (farms)	52	88	108
Hogs and pigs inventory (number)	7,949	14,203	17,065
Hogs and pigs sold (farms)	49	89	112
Hogs and pigs sold (number)	14,364	26,356	27,198
Sheep and lambs inventory (farms)	27	27	37
Sheep and lambs inventory (number)	523	1,282	949
Layers and pullets 13 weeks old and older inventory (see text) (farms)	32	45	62
Layers and pullets 13 weeks old and older inventory (see text) (number)	976	(D)	2,795
Broilers and other meat-type chickens sold (farms)	5	11	10
Broilers and other meat-type chickens sold (number)	283	782	880
Corn for grain or seed (farms)	373	404	596
Corn for grain or seed (acres)	42,188	39,798	39,847
Corn for grain or seed (bushels)	4,550,863	3,271,022	3,684,369
Wheat for grain (farms)	155	206	205
Wheat for grain (acres)	6,918	7,744	5,565
Wheat for grain (bushels)	361,368	318,398	243,064
Soybeans for beans (farms)	123	85	38
Soybeans for beans (acres)	14,120	5,743	2,520
Soybeans for beans (bushels)	526,560	163,833	91,803
Dry edible beans, excluding dry limas (farms)	17	18	9
Dry edible beans, excluding dry limas (acres)	2,876	2,243	1,346
Dry edible beans, excluding dry limas (hundredweight)	50,270	32,961	19,108
Hay-alfalfa, other tame, small grain, wild grass silage, green chop, etc(see txt)(farms)	553	634	757
Hay-alfalfa, other tame, small grain, wild grass, silage, green chop, etc(see txt)(acres)	30,713	34,196	39,950
Hay-alfalfa, other tame, small grain, wild grass, silage, green chop, etc(see txt)(tons, dry)	78,350	89,707	109,579
Vegetables harvested for sale (see text) (farms)	80	114	118
Vegetables harvested for sale (see text) (acres)	3,747	4,507	4,311
Land in orchards (farms)	184	236	257
Land in orchards (acres)	15,143	16,988	16,332

(D) Withheld to avoid disclosing data for individual farms.  
(N) Not available.

Data From: "Census of Agriculture: 1987, 1992, 1997." GovStats. Oregon State University Libraries. Updated: February 28, 2002. Retrieved: November 23, 2003.  
<<http://govinfo.kerr.orst.edu/php/agri/show2.php>>



## Lower Grand River Watershed Project

### Target Audience Profile

Target Audience: Business Owners

1. What is the makeup of the target audience (answer if appropriate)?
  - a. Average Age: Adult
  - b. Gender M/F
  - c. Place of Residents (home or apartment, any unique characteristics)  
Most residing in Grand River Watershed, if not Buck Creek
  - d. Level of Education: Varied
  - e. Level of Income: Varied
  - f. Other pertinent facts: Is very urban area with numerous types of businesses
2. How do they communicate with each other? Trade newsletters, magazines, conferences, day to day business operations.
3. How do they receive information on environmental issues? Regulations on industrial processes and waste disposal, as well as through mass media.
4. Of what other community organizations are they members? \_\_\_\_\_
5. What are their major environmental concerns: Sustainable business practices.



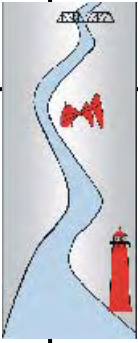
## Lower Grand River Watershed Project

### Target Audience Profile

Target Audience: Builders and Developers

1. What is the makeup of the target audience (answer if appropriate) ?
  - a. Average Age N/A
  - b. Gender Majority is Male
  - c. Place of Residents (home or apartment, any unique characteristics) Focused on Ottawa and Kent County, not townships
  - d. Level of Education: Specialized on building tasks, not overly scientific technical information.
  - e. Level of Income: varies by number of projects and size of company
  - f. Other pertinent facts: Group does better with hands on items that can be used at work site rather than with products or meetings that take them away from projects.
2. How do they communicate with each other? Newsletters, workshops, educational programs supplied by Home Builders Association
3. How do they receive information on environmental issues? Regulations governing construction activities, classes required to obtain permits, newsletters, and mass media.
4. Of what other community organizations are they members? Home Builders Association
5. What are their major environmental concerns: Depends on builder, a lot of emphasis is put on erosion and sediment controls, will want environmental practices that help to sell homes, aesthetically, practically, and financially.

Information from Home Builders Association, phone interview with Mr.  
Chris Hall, November 24, 2003



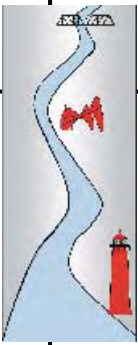
## Lower Grand River Watershed Project

### Target Audience Profile

Target Audience: Homeowners

1. What is the makeup of the target audience (answer if appropriate) ?
  - b. Average Age Varied
  - c. Gender M/F
  - d. Place of Residents (home or apartment, any unique characteristics)  
Owner Occupied Housing Units: 118,816
  - e. Level of Education: 87.67% high school diploma or more
  - f. Level of Income: Household median income, \$52,630
  - g. Other pertinent facts: can get possible riparian homeowner listing from Grand Valley REGIS program
2. How do they communicate with each other? Through mass media, Advance is the local newspaper, attending children's' school events, church events, one on one  
\_\_\_\_\_  
\_\_\_\_\_
3. How do they receive information on environmental issues? Flyers, newspaper, radio, television, home improvement stores.  
\_\_\_\_\_  
\_\_\_\_\_
4. Of what other community organizations are they members? Homeowners associations, schools, churches, etc.  
\_\_\_\_\_
5. What are their major environmental concerns: Value of homes, safeness of area for family.  
\_\_\_\_\_  
\_\_\_\_\_

Data from same source as urban residents.



## Target Audience Profile

Target Audience: Locally Elected Bodies

1. What is the makeup of the target audience (answer if appropriate)?
  - a. Average Age 30+
  - b. Gender M/F
  - c. Place of Residents (home or apartment, any unique characteristics)  
Generally residing in watershed or close to watershed, many living in own homes
  - d. Level of Education: High school and up
  - e. Level of Income: varied
  - f. Other pertinent facts: Have townships of Alpine, Chester, Tallmadge, and Wright, and City of Walker involved, along with Ottawa County Commissioners
2. How do they communicate with each other? Board meetings, planning meetings, day to day operations. Also, often being friends and neighbors of the same community, there are ample opportunities to communicate at local venues such as church and school functions as well as local socially oriented businesses such as restaurants or entertainment spots.
3. How do they receive information on environmental issues? Since many locally elected officials have "day jobs" it depends on their other associations. Many are involved in occupations where they may receive information on such issues from sources slanted to a point of view, depending upon the occupation. Also, information on a specific issue upon which they are deliberating may well be supplied by applicants or professionals hired to inform them on specific aspects of such an issue as part of the legislative or administrative review. Information may also be found in publications associated with membership organizations such as those cited below.
4. Of what other community organizations are they members? Grand Valley Metro Council, Michigan Township Association, Michigan Municipal League, Michigan Association of Counties, local chapters of some of these organizations as well as national counterparts organizations, though these are not as active. There may also be memberships associated with smaller geographical levels such as neighborhood associations, business associations and other special purpose organizations such as watershed groups or multi-jurisdictional discussion groups. Other important groups are based more on profession such as Michigan Local Government Managers Association, and ICMA.
5. What are their major environmental concerns? Accomplishing the decisions of their constituents, to implement cost effective measures, meet regulated standards for stormwater. To ensure appropriate levels of development and redevelopment occurs without causing health and safety concerns for local residents, businesses and other constituents. Getting their jobs done on a daily basis without doing great and obvious harm to major environmental assets.

Information is from Andy Bowman, Grand Valley Metro Council, on November 26, 2003.





## Lower Grand River Watershed Project

### Target Audience Profile

Target Audience: Municipal Employees

1. What is the makeup of the target audience (answer if appropriate)?
  - a. Average Age Varied
  - b. Gender M/F
  - c. Place of Residents (home or apartment, any unique characteristics)  
In Grand River Watershed, if not Buck Creek
  - d. Level of Education: Varied
  - e. Level of Income: Varied
  - f. Other pertinent facts: Pay special attention to departments that deal with streets and highways, water transport, water supply at both the County and City level.
2. How do they communicate with each other? Staff meetings, telephone, email, training seminars, day to day operations, websites.
3. How do they receive information on environmental issues? Regulations, policies, mass media, and through training.
4. Of what other community organizations are they members? Varies
5. What are their major environmental concerns: Safe workplace, cost effective control measures, within mandated levels for pollutants.